Student and Classroom Variables Improving Student Engagement in Mathematics

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Abstract

The study explored what student and classroom variables affected student engagement in mathematics. Since students were nested within a classroom, hierarchical linear modeling (HLM) was employed for the analysis. The results represented that students' gender, SES, and prior achievement made differences in student engagement. Teachers' years of experience, certification, and degree had direct and indirect effects on student engagement level. Small size class had positive effects on student engagement, and content coverage also increased student engagement. Authentic instruction reduced the gender gap of student engagement.

Key words: student engagement, hierarchical linear modeling, authentic instruction, content coverage

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I Introduction

One of the most fundamental research questions in education is how schools can help students learn more in a classroom. Previous research has focused on the teacher as a representative resource that improves students' learning in schools. The importance of qualified teachers in reforming schools is publicly known as evident in the U.S. government to educate and recruit good teachers. Even though quality teachers are good explanation for quality education, good teachers do not always bring students' successful learning.

The unsolved part should be found in students because education is an interactive phenomenon between teachers and students. Among the variables that affect students' learning, the most immediate and persistent issue for students and teachers is student engagement. Research finds out that the most obviously disengaged students disrupt classes, skip them, or fail to complete assignments. In contrast, engaged students make a psychological investment in learning and try hard to learn what a class offers. They take pride not simply in earning the formal indicators of success (grades), but in understanding the material and incorporating or internalizing it in their lives (Newmann, 1992).

In spite of the significant impact of engagement, research studies over the past two decades have documented low levels of student engagement in U.S. schools (Goodlad, 1984; Steinberg; 1996). Enhancing student engagement has been a challenge to educators, and efforts to increase student engagement have been a theme of school reform over the past decade. Much of the research has attributed the lack of engagement to students' personal backgrounds or to characteristics of their schools such as curricular

fragmentation, weak instruction, and low expectations for student learning (Marks, 2000).

Research on factors that might improve engagement, especially on teacher variables affecting engagement, is sparse. There are some studies about instructional style (teaching quality) and student engagement but they do not include teachers' individual characteristics (teacher quality)*. The lack of research is surprising when it is considered that teachers are the most significant people in schools for boosting student engagement and achievement (Brandt, 1998; Hill & Crevola, 1999; Newmann, 1992; Strong et al., 1995; Wasley, 1999; Wolfe, 1998). To help address these shortcomings, this study will include measures of teacher quality as well as those of teaching quality for independent variables. It is expected that verifying teacher qualities and classroom variables that affect student engagement will help policy makers and administrators to make a research-based decision.

The research question for this study is what student variables and teacher variables independently and interactively affect student engagement. For the analysis, multi-level modeling or hierarchical linear modeling (HLM) is employed. Multi-level modeling is an extension of regression analysis and gives a good solution to figure out type I error inflation and aggregation bias problems. HLM helps an investigator to find out with more accuracy the effects of an upper unit variable (e.g. classroom) on lower unit outcomes (e.g. students) with a multi-level structure. With high external validity, the *Prospects* data that are nationally

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* Kaplan& Owings distinguish between teacher and teaching quality. Teacher quality indicates teacher individual characteristic such as demographics, aptitude, professional preparation, and college majors, while teaching quality refers to what teachers actually do in the classroom to improve student learning.

surveyed are analyzed.

Ⅱ Engagement Theory

Engagement has been defined as "active involvement, commitment, and concentrated attention, in contrast to superficial participation, apathy, or lack of interest" (Newmann et al., 1992: 11). Marks (2000) synthesized the definitions of student engagement employed by several researchers and defined engagement as a psychological process, specifically, the attention, interest, investment, and effort students expended in the work of learning. Fredricks et al. (2004) also synthesized the related literature and described three aspects of student engagement that are behavioral, emotional, and cognitive.

A. Effects of Engagement

Finn (1993) found that there was a strong linear association of participation with academic achievement. In other words, the higher the participation level, the higher the achievement scores in reading, mathematics, science, and social studies. Newmann et al. (1992) underscored the significance of student engagement by citing students' interviews. The students in their study stated that being engaged in their studies encouraged them to work hard. In most studies, there were no significant interactions of participation with gender or race/minority (Greenwood, 1991). That is, the strong association of participation with achievement was supported for male and females, and for Asian, Hispanic, African American, and non-Hispanic White students alike. Hines et al. (1986) showed that task

engagement mediated teacher behavior and student achievement. Silverman (1985) showed student characteristics mediated engagement and outcomes in physical education.

B. Factors That Affect Engagement

1. Student Background and Engagement

Marks' study (2000) explored the influence of students' personal backgrounds on students' engagement in instructional activities. Newmann et al. (1992) found that race, gender, achievement and socio-economic status caused different levels of student engagement. According to their explanation, different levels of student engagement were caused by the sense of unfairness from differences in race, gender, achievement, and social-economic status (Newmann et al., 1992). Several studies have found that across all grade levels, girls were significantly more engaged in instructional activity than boys (Finn, 1989; Finn & Cox, 1992; Lee & Smith, 1993). In these same studies social class was also discovered to also significantly make differences in student engagement level at all grade levels (Finn, 1989; Finn & Cox, 1992; Lee & Smith, 1993). Their studies concluded that students from low social-economic status (SES) with poor records of achievement got teachers' lower expectations and less attention in class (Gamoran & Berends, 1987; Goodlad, 1984; Oakes, 1990). Because, as described above, high level of engagement brought good academic achievement, students of low SES tended to be more weakly engaged with class and school work, which resulted in low academic achievement. At the same time, prior achievement was another factor affecting student engagement. Studies by Lee & Smith (1993, 1995) showed

that more academically successful middle and high school students reported greater engagement with school and class work. Borman & Rachuba (2001) also reported that academic success among poor and minority elementary school students was highly related to greater academic engagement.

The relationship between minority status and student engagement seems to be affected by grade level and SES. Finn and Cox's study (1992) showed that minority students were less engaged academically in elementary schools. On the other hand, Lee & Smith (1995) contended that minority high school students were more likely to be engaged in their academic work than non-Hispanic White students. In middle schools, students did not show significant differences in academic engagement depending on minority status (Lee & Smith, 1993). SES was another factor that affected the relationship between minority status and student engagement (Lee & Smith, 1993). Minority students from low-income homes tended to be disengaged in the classroom (Steele, 1992).

2. Teacher and Teaching Quality, Student Engagement and Student Achievement

The importance of good teaching for the students' academic success is intuitively obvious to any parent and is well substantiated by a body of sound research (The Abell Foundation, 2001). Increasingly, research confirms that teachers' classroom expertise is an essential factor in student achievement (Darling-Hammond, 1999; Hill & Crevola, 1999; Sanders & Rivers, 1996). However, there is disagreement on who are good teachers and on what are the criteria to measure teacher quality. That is because good

teachers possess a mixture of characteristics that cannot always be quantified, such as patience, enthusiasm, inspiration, creativity, and passion for the subject they teach and for teaching itself (Palmaffy, 1999). This invisibility of qualification for good teachers makes administrators or principals set such visible criteria as degrees, scores, or certificates (The Abell Foundation, 2001). Still, it is inconclusive whether such visible criteria as degrees, scores, or certificates are appropriate for evaluating teachers.

As a source of enhanced student engagement, authentic instructional work measures how much the work that the students are asked to do in academic subjects is cognitively challenging and connected to the world beyond the classroom. According to Marks' research (2000), authentic instructional work is a powerful contributor to the engagement of elementary, middle, and high school students because authentic academic work involves students in solving meaningful problems with relevance in the world beyond the classroom and of interest to students personally.

Newmann et al. (1992) similarly argued that authentic work affected student engagement. They used the term of authentic work "to characterize tasks that are considered meaningful, valuable, significant, and worthy of one's effort". According to them, authentic work connected instruction to the real world and it has a positive relationship with student engagement, which results in higher academic achievement (Newmann et al, 1992).

Student-centered instruction (Keeday & Drmacich, 1991), interactive teaching techniques (Jones & Warren, 1991), and instructional discourse (Nystrand & Gamoran, 1989) can be regarded as critical indicators of authentic instruction and they are not separately distinguished. Each study shows that these instructional practices help improve student

engagement. Nystrand & Gamoran (1991) explored the positive effects of instructional discourse on student engagement, which reflected students' ideas and included vivid interactions between students and teachers. Related to the effects of teachers' efforts for student engagement, several studies find that various teachers' techniques for student engagement in schoolwork enhance students' successes in schools (Brandt, 1998; Hill & Crevola, 1999; Newmann, 1992; Strong et al., 1995; Wasley, 1999; Wolfe, 1998).

3. Small Class and Student Engagement

Theoretically small size classes have a positive effect on student social behavior because individual communications increase among individuals (Bryk & Driscoll, 1988). Empirical studies on the relationship between size and engagement are not quite developed (Finn, 2002). The *STAR* project showed that students' engagement in learning was high in a small size class (Finn, 1989). Finn (2002) focused on students' social behavior in order to explain the consistent academic benefits of a small size class. Finn (2002) hypothesized that students in a small class became more engaged in learning, and displayed more prosocial behavior and less antisocial behavior. In spite of considerable variety in research quality, most research on students' engagement in learning supported this hypothesis (Finn, 2002).

Ⅲ Methods

A. Sample and Variable Description

The analyzed *Prospects* data were collected from the spring of 1991 to the spring of 1994. The focus of this paper is on the sample of about 15,000 first grade students and about 600

teachers from the fall to spring of the 1991~1992 school year. Using proportionate allocation, a probability sample of students would have included only about 15 to 20 percent of population (Jones et al., 1991: 6~7). Student and classroom variables are summarized in Table 1. Student's gender, race, SES, and prior achievement were selected because they are significant student background variables in most studies. Student engagement, authentic instruction, and content coverage were constructed based on the previous research and theory.

Table 1. Variable and Sample Description

Classroom Variables	**Coding**	**Frequency**	**Valid Percent**
Certification	A categorical variable answering for types of certification		
No certification	0	9	1.5
Probationary/temporary	1	40	6.8
Permanent	2	537	91.6
Missing		106	
Total		602	100
Teacher's degree	A dichotomous variable indicating whether or not a teacher had the master's degree		
Master's degree and above	1	211	35.9
Below master's degree	0	376	64.1
Missing		15	
Total		602	100
Class size	A dichotomous variable indicating whether or not the number of students enrolled was below 15.		
Small class	1	73	12.5
Large class	0	511	87.5
Missing		18	
Total		602	100
Student Variables	**Coding**	**Frequency**	**Valid Percent**
Gender			
Male	1	6,543	51.6
Female	0	6,140	48.4
Missing		2,196	
Total		14,879	100
Race			
Non-minority	0	5,962	51.0
Minority	1	5,722	49.0
Missing		3,195	
Total		14,879	100

Classroom Variables	Number of Cases	Mean	Standard Deviation	Description
Years of Experiences	587	13.48	8.97	A continuous variable based on teachers' answers for the question, "how many years in total have you taught at either elementary or secondary level?"
Degree of Authentic Instruction	571	0	1	A standardized composite measure of the degree of student-centered instruction interactive teaching, and instructional discourse (α .65)
Content Coverage	554	0	1	A standardized composite measure of the degree of higher-order thinking skills (α .71)
Student Variables				
Prior Achievement	10,594	0	1	Standardized fall 1991 CTBS total math scale score.
Student Engagement	12,504	0	1.00	A standardized composite measure of student's attendance patterns, doing classwork, attentive in class, and discipline (α .80)
SES	10,351	0	1.00	A standardized composite measure of parents' educational level, occupational prestige, and total family income.

Indicators of student engagement consist of attendance patterns, discipline, and curricular activities according to Finn's theory (Finn, 1993). (Table 2)

Table 2. Items for Measuring Student Engagement

Source	Items
Student Profile recorded by teachers	How many days of school did this student miss this school year?
	How many times was the student late for school this school year?
	Indicate the number of times this student has ever been suspended from school this year (Suspension means the student is asked to leave for a period of time, but is permitted to come back to the school this year).
	This student pays attention in class.
	This student disrupts the class.
	This student is willing to follow rules.
	This student can understand and follow directions.
	This student completes homework assignments.
	This student completes seatwork (classroom) assignment.
	This student asks questions in class.
	This student volunteers answers/take part in class discussions and conversations.
	This student works hard at school.
	This student cares about doing well in school.
	This student gets along with teachers.
Parents questionnaire	I think my child believes he or she cares about doing well in school.
	I think my child believes he or she gets along with teachers.
	I think my child believes he or she enjoys school.

B. Analytical Approach

Regarding classroom effects on student engagement, multi-level data analysis was implemented in this study. When students are nested within classes, and classes are, in turn, nested within schools, and schools within districts, we use terms of “multi-level” or “hierarchy” to describe these data structures. Traditional regression models ignore

dependency, which causes "aggregation bias" and a faulty conclusion about the effects of variables (Van der Leeden, 1998: 271~273). Multilevel data analysis overcomes the weaknesses of traditional regression models (Guo & Hussey, 1999; Kreft & Leeuw, 1998).

The data that are used here have a hierarchical relationship. Students are regarded as the first level, and classroom variables that students belong to are located in the upper level (level-2). Multilevel modeling is the most appropriate method to be implemented because student and classroom characteristics affect student engagement with two-level data structure. The main research question is to see what effects student and classroom variables have on student engagement. These relationships are expressed with the following equations.

$$\text{Student engagement} = \beta_{0j} + \beta_{1j}(\text{Gender})_{ij} + \beta_{2j}(\text{Race})_{ij} + \beta_{3j}(\text{SES})_{ij} + \beta_{4j}(\text{Prior Achievement})_{ij} + e_{ij}$$

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{yrs. of experience})_j + \gamma_{02}(\text{certification})_j + \gamma_{03}(\text{highest degree earned})_j + \gamma_{04}(\text{small class})_j + \gamma_{05}(\text{authentic instruction})_j + \gamma_{06}(\text{content coverage})_j + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}(\text{yrs. of experience})_j + \gamma_{12}(\text{certification})_j + \gamma_{13}(\text{highest degree earned})_j + \gamma_{14}(\text{small class})_j + \gamma_{15}(\text{authentic instruction})_j + \gamma_{16}(\text{content coverage})_j + u_{1j}$$

$$\beta_{2j} = \gamma_{20}$$

$$\beta_{3j} = \gamma_{30} + \gamma_{31}(\text{yrs. of experience})_j + \gamma_{32}(\text{certification})_j + \gamma_{33}(\text{highest degree earned})_j + \gamma_{34}(\text{small class})_j + \gamma_{35}(\text{authentic instruction})_j + \gamma_{36}(\text{content coverage})_j + u_{3j}$$

$$\beta_{4j} = \gamma_{40} + \gamma_{41}(\text{yrs. of experience})_j + \gamma_{42}(\text{certification})_j + \gamma_{43}(\text{highest degree earned})_j + \gamma_{44}(\text{small class})_j + \gamma_{45}(\text{authentic instruction})_j + \gamma_{46}(\text{content coverage})_j + u_{4j}.$$

β_{0j} represents intercept, β_{1j} is a coefficient and e_{ij} is an error term. β_{0j} is the average student engagement in a classroom j, and β_{1j} represents the relationship between student variables and student engagement in a classroom j. The γ^{*}_{1}, γ^{*}_{2}, γ^{*}_{3}, γ^{*}_{4}, γ^{*}_{5}, and γ^{*}_{6} reflect the classroom-level prediction coefficients, and u_{*j} represents level-2 residuals. Student background variables such as students' gender, SES, race, and prior academic achievement are used as predictors in the level-one analysis. Classroom variables are composed of class size, teacher's years of experience, types of certification, highest degree earned, depth of authentic instruction and content coverage within a classroom j. β_{2j} does not have the second level predictors because the effects of race turn out same across the classrooms.

Ⅳ Results

A. Empty model

Multilevel analysis begins with an empty model that has no student- or teacher-level predictors. The purpose of this analysis is to estimate the overall average of the outcome measure (student engagement) and partition the variance in the outcomes into between-teacher and within-teacher components. This also shows an initial estimate for the intra-class correlation of the response variable 'student engagement'. The variance is composed of two parts: a student-level and a teacher-level variance. Intra-class correlation is obtained by dividing the school variance into the total variance. The results of this empty model help to test if the added independent variables significantly explain the variance.

The within and between variances of an empty model can be regarded as a criterion to estimate the multiple correlation R^2, a concept derived from traditional regression analyses. A difference between this two-level analysis and traditional regression is that the traditional regression has only one source of variance. In two-level analyses, the explanatory variables explain the two sources of variation. It means that there are two R^2s. The level-one R^2 is based on the traditional error variance at the student level, while the level-two, teacher level R^2 is newly introduced.

Table 3 displays the results of the empty model analysis. The estimate of average student engagement is 0.0396, which is statistically significant. The student level variance for student engagement is 0.2189 that is larger than the between-classroom variance, 0.1412. This indicates that the effect of student variables is bigger than the effect of classroom variables. The proportion of variability of between-classroom variance is represented by the intra-class correlation value, which is calculated as the ratio of the between variance to the total variance. The value is 0.3930 [0.1412/(0.1412+0.2189)], which is enough for multilevel analysis to be implemented. In addition, significant X^2 values for u_{0j}'s show variability among classrooms.

Table 3. Empty Model for Student Engagement in Mathematics

Fixed effect	***Coefficient***	***se***	***T ratio***
Classroom mean student engagement, γ_{00}	0.0396***	0.0074	5.33
Random effect	***Variance Component***	***df***	X^2
Classroom mean student engagement, u_{0j}	0.1412***	5454	12875.56
Level-1 effect, γ_{ij}	0.2189		

* p ≤ 05, ** p ≤ 01, *** p ≤ 001

B. Within-Classroom Model

The within-classroom model is conceptually analogous to separate ordinary least squares (OLS) regressions within a classroom. In the case of the within-classroom model, classrooms have the same student-level variables. At level one, student engagement for student i under classroom teacher j is regressed on student' gender, race, SES, and prior academic achievement. The exploratory analysis shows that all X^2 indices for random part of level-one variable slopes are significant except for the minority slope. That is why variability for the minority status variable is fixed.

Table 4. Within-Classroom Model for Student Engagement in Mathematics

Fixed effect	***Coefficient***	***se***	***T ratio***
Classroom mean student engagement, γ_{00}	0.0243**	0.0076	3.193
Gender differentiation, γ_{10}	-0.1572***	0.0107	-14.716
Race differentiation, γ_{20}	0.0001	0.0003	0.315
SES differentiation, γ_{30}	0.0714***	0.0077	9.255
Prior achievement differentiation, γ_{40}	0.0020***	0.0001	21.585
Random effect	***Variance Component***	***df***	X^2
Classroom mean student engagement, u_{0j}	0.1246***	46	1820.4479
Gender slope, u_{1j}	0.0041***	46	130.0465
SES slope, u_{3j}	0.0040***	46	168.0102
Prior achievement slope, u_{4j}	0.0000***	46	194.2330
Level-1 effect, γ_{ij}	0.1867***		

* p ≤ 05, ** p ≤ 01, *** p ≤ 001

The results show that gender has negative effects for student engagement. Since girls are coded as 0 and boys

are 1, it can be interpreted that girls are 0.1572 more engaged than boys. There are positive SES effects on student engagement, which means that the students with higher SES tend to be 0.0714 more academically engaged. The effects of prior achievement are also significant. Academically higher achieved students have 0.0020 higher level of student engagement. Student engagement level between minority and non minority students has no differences.

The variance of γ_{ij} in Table 4 represents the unexplained residual variance at level-one after considering students' gender, race, SES, and prior achievement. When the results are compared with those of the empty model, the variances at level-one and at level-two are reduced. Calculating the proportion of this reduction results in two measures for explained variance, the student R^2 and the classroom R^2. The level-one variance is reduced from 0.2189 to 0.1867, the difference is 0.0322. It means that the student variables explain 17.71% [(0.2189 0.1867)/0.2189=0.1471] of student-level variance. The level-two (classroom) variance is reduced from 0.1412 to 0.1246, and the decrease of 0.0166 represents a 11.76% [(0.1412 0.1246)/0.1214=0.1176] reduction of the classroom-level variance. In other words, added student-level variables explain 11.76% of classroom-level variance in mathematics class.

C. Between-Classroom Model

When the basic assumption is that the student engagement is interactively affected by both student-level and classroom-level variables, classroom-level variables are supposed to be added. The results of the full model are presented in Table 5. Among classroom variables that affect

classroom mean student engagement, teacher's years of experiences and certification type have negative effects on student engagement (-0.0025 and -0.1139 for each). It means that teachers with less experience and with no certification tend to lead students to be more engaged. According to Table 5, small class size has positive effects on student engagement (0.0064). In other words, the students in the small classroom are more engaged. Content coverage also has positive effects on student engagement (0.0240). If teachers cover challenging content in mathematics classroom, students seem to be more engaged.

Authentic instruction has negative effects on gender slope, which represents that authentic instruction reduces the student engagement gap between girls and boys (-0.0349). Teachers' master degree contributes to decreasing the student engagement gap between higher and lower achievers (-0.0004). On the other hand, teachers' certification rather widens the student engagement gap between higher and lower achievers (0.0009). However, the effects of certification type and degree status on prior achievement slope are too small to be practically meaningful. When this model is compared with the within-classroom model (refer to Table 4), the classroom-level variance is reduced by 0.0042. It means that 3.37% of the variance in average student engagement is explained by classroom variables [(0.1246-0.1174)/0.1246=0.0337].

Table 5. Between-Classroom Model for Student Engagement in Mathematics

Fixed effect	*Coefficient*	*se*	*T ratio*
Classroom mean student engagement			
Intercept, γ_{00}	0.0257***	0.0077	3.345
Years of experience, γ_{01}	-0.0025***	0.0007	-3.770
Certification type, γ_{02}	-0.1139***	0.0307	-3.706
Highest degree earned, γ_{03}	0.0083	0.0130	0.641
Small class, γ_{04}	0.0064***	0.0013	4.818
Authentic Instruction, γ_{05}	0.0190	0.0099	1.929
Content coverage, γ_{06}	0.0240**	0.0089	2.692
Gender differentiation			
Intercept, γ_{10}	-0.1583***	0.0102	-15.463
Years of experience, γ_{11}	0.0006	0.0013	0.439
Certification type, γ_{12}	-0.0243	0.0239	-1.019
Highest degree earned, γ_{13}	0.0165	0.0227	0.724
Small class, γ_{14}	0.0020	0.0021	0.949
Authentic Instruction, γ_{15}	-0.0349*	0.0176	-1.982
Content coverage, γ_{16}	-0.0086	0.0154	-0.056
Race differentiation			
Intercept, γ_{20}	0.0006	0.0003	1.674
SES differentiation			
Intercept, γ_{30}	0.0687***	0.0072	9.592
Years of experience, γ_{31}	0.0005	0.0008	0.664
Certification type, γ_{32}	0.0323	0.0211	1.534
Highest degree earned, γ_{33}	0.0180	0.0149	1.207
Small class, γ_{34}	-0.0022	0.0014	-1.496
Authentic Instruction, γ_{35}	-0.0096	0.0127	-0.753
Content coverage, γ_{36}	0.0039	0.0106	0.373
Prior achievement differentiation			
Intercept, γ_{40}	0.0020***	0.0001	23.821
Years of experience, γ_{41}	-0.0000	0.0000	-0.109
Certification type, γ_{42}	0.0009***	0.0003	3.263
Highest degree earned, γ_{43}	-0.0004*	0.0002	-2.230
Small class, γ_{44}	-0.0000	0.0000	-1.917
Authentic Instruction, γ_{45}	-0.0000	0.0001	-0.277
Content coverage, γ_{46}	-0.0000	0.0001	-0.388
Random effect	***Variance Component***	***df***	X^2
Classroom mean student engagement, u_{0j}	0.1174***	142	3155.4608
Gender differentiation, u_{1j}	0.0046***	142	220.8294
SES differentiation, u_{3j}	0.0038***	142	325.8902
Prior achievement differentiation, u_{4j}	0.0000***	142	324.3823
Level-1 effect, γ_{ij}	0.1861		

* p ≤ 05, ** p ≤ 01, *** p ≤ 001

V Conclusion

A. Summary and Interpretation of the Findings

The purpose of this research was to find an answer for what are the variables to affect student engagement. At the student-level, gender, SES, and prior achievement were found to have significant effects on student engagement. Girls are significantly more engaged in academic activities, which is consistent with previous research results (Finn, 1989; Finn & Cox, 1992; Lee & Smith, 1993). Socio-economic status (SES) has a positive effect on student engagement. High SES students tended to be more engaged than low SES students, which is the same conclusion as the previous research (Finn, 1989; Finn & Cox, 1992; Lee & Smith, 1993). Although the effect size is small, prior achievement also positively affected student engagement. The results of this research extend the line of investigation of Lee & Smith's studies (1993, 1995) which explored the hypothesis that more academically successful middle and high school students are more engaged with school and class work. Regarding the race effects, student engagement was not significantly different across different races. Previous studies also showed the controversial results related with minority status depending on grade level or socio-economic status. Minority status also did not bring the significant differences in Lee & Smith's study (1993).

So far, research on teacher attributes has shown a great deal of conflicting results. Hanushek's studies have shown inconsistent effects of teachers' experience (Hanushek, 1971; 1986; 1992). Hanushek et al. (1998) found that one or two years of experience improved a teacher's quality but the additional years had an insignificant impact. In addition,

there is no agreement on effects of a teacher's certification. In spite of strong support from policymakers and administrators in most states, the effect of certification is questioned by the researchers who conclude that certified new teachers do not produce greater student gains than non-certified new teachers (Bradshaw & Hawk, 1996; Goldhaber & Brewer, 1999; 2000; Lutz & Hutton, 1989; Miller et al., 1998; Raymond et al., 2001).

The results of this research show a positive relationship between small class size and student engagement. Even though the effect size is too small to say that small classes make actual differences in student engagement, the positive relationship means that students in smaller classes are more engaged in academic activities. The relationship between small class size and student engagement is consistent with previous research. Finn (1989) found that there was a positive relationship between student engagement and small class size based on the *STAR* project.

This research presents the positive relationship between content coverage and student engagement. It means that student engagement is increased if a teacher teaches cognitively demanding skills. Several studies have explored the relationship between content coverage and student academic achievement, but it is hard to find research that studies the relationship between content coverage and student engagement. According to the results of this study, it can be said that the cognitively demanding curriculum is most likely to involve students in studying mathematics.

Authentic instruction contributes to closing the student engagement gap between female and male students. The negative effects of authentic instruction on the gender slope show that the gender slope is less steep when more authentic instruction is implemented. When authentic

instruction is characterized as meaningful, valuable, significant, and worthwhile work in a student's everyday life (Newemann et al., 1992), it is universally effective for all students. If students are asked to apply their knowledge into the real world, gender differences of student engagement will be reduced. This mediating effect of authentic instruction is an example that shows how multi-level modeling works with level-one and level-two variables.

This study indicates that teachers' certification type and master's degree also have mediating effects on student engagement but the effect size is very small. Certification tended to widen the student engagement gap between higher and lower achievers, while master's degree narrows the gap. The effects of the certification and degree are still inconclusive given the conflicting conclusions on teacher attributes in previous research (The Abell Foundation, 2001).

B. Limitations and Suggestions for Further Study

This research study is meaningful in that it explores classroom level as well as student level variables that make differences in student engagement. However, this research has some limitations. First, this study does not apply full definition of student engagement by selecting the first graders as sample. This limited application of student engagement may cause distorted results. Therefore, a student engagement study needs to be extended through middle and high school years. This extended research will help to make a full application of the student engagement definition and to find the actual effects of it. Secondly, the *Prospects* data do not allow the researchers to track the teachers longitudinally by giving teachers different identification numbers year by year. A longitudinal study needs to be conducted to find the actual teacher effects on student engagement in the future.

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